5. CONCLUSION

As there are a variety of UWB signal types, there can be a multitude of receiver responses, depending upon the characteristics of the interfering signal and the method of power representation. For these measurements, a UWB signal space was generated by varying the parameters of pulse-spacing, PRF, and gating. The temporal and spectral characteristics of the interfering signal, as transformed by the receiver transfer function, are dependent on not only the nature of the transmitted interfering signal but also on the bandwidth and filter characteristics of the receiver.

The UWB signal, when altered by the receiver passband transfer function, can appear impulsive, Gaussian noise-like, sinusoidal, or a combination of the above. When a narrow pulse with a wide bandwidth is passed through a filter with a narrower bandwidth, the output approximates the impulse response of the filter, the result being that the output has a pulse width approximately equal to the reciprocal of the receiver bandwidth with an oscillation at the center frequency of the filter. As the pulses pass through the receiver filters, they become wider, and depending upon the PRF and extent of dithering, the pulses may overlap. It is the combination of these receiver characteristics and the nature of the interfering UWB signal (PRF, pulse spacing mode, and gating) that determines the properties of the signal as it passes through the signal processing chain of the receiver.

When passed through the receiver, the dithered and on-off-keyed UWB signals can take on impulsive or Gaussian noise-like characteristics, depending upon the PRF and the bandwidth of the receiver. Because the phase of the oscillation is dependent upon the time origin of the pulse, the phase for adjacent dithered pulses can be asynchronous. This can result in constructive and destructive summation of signal components for overlapping pulses, giving the appearance of Gaussian noise. OOK signals, while synchronous in phase for adjacent pulses, can take on a similar noise-like appearance when adjacent pulses overlap; however, OOK signals also have spectral lines, whereas dithered signals (depending upon the degree of dithering and the bandwidth and center frequency of the receiver) typically have no spectral lines. If the PRF of a UWB signal is sufficiently low (PRF to receiver bandwidth < 1), the pulses do not overlap, and therefore, the signal becomes impulsive in nature as it passes through the receiver.

Both OOK and UPS signals have spectral lines spaced at intervals equal to the PRF. Depending upon the bandwidth and center frequency of the receiver filters, one or more of these spectral lines can be passed to the receiver. If a single spectral line of a UPS signal is passed, the interference looks CW in nature. OOK is hybrid in nature, showing both spectral lines and noise-like spectral components. As more and more spectral lines are passed, the interference effects start to approach that of a Gaussian noise-like signal.

For the same 1-MBPD, experience has shown that many receivers incur the least interference from impulsive-type signals and the greatest interference from CW signals, with Gaussian noise lying somewhere in between [3] [4]. In this particular experiment, the receivers' bandwidths are narrow enough and the PRFs high enough that none of the generated signals were impulsive with regard to their effects. In both the 100-kHz case and the 20-MHz case, the pulses, as they are altered by the receiver processing chain, overlap; therefore, for both the 50%-ARD and the 2%-RRD signals, the interference effects are very similar to Gaussian noise. At the PRFs of 100 kHz and 20 MHz, both UPS and OOK signals have at most only a single spectral line that passes through the receiver filters. For this reason, the effects on the receiver are CW-like. For UPS, where the spectrum is only composed of lines, the effect on the receiver is identical to CW signals. For equal 1-MBPD, the 100-kHz UPS signals appear to be less harmful only because, for the 100-kHz case, there are 10 spectral lines within the 1-MHz band of power measurement, but only one of those spectral lines passes through the receiver filters. On the other hand, for the 20-MHz case, there is only one spectral line within the 1-MHz band of power measurement, and all of the power of that spectral line passes through the receiver filters. OOK signals, though they contain spectral lines, have some of the power distributed into Gaussian noise-like spectral components and therefore, for the same 1-MBPD, are not as interfering as the UPS counterpart.

Gated UWB signals, when measured in terms of their power during the gated on-time, require a decrease in power by a factor of 10 $\log_{10}$ (*gating duty cycle*) to get a similar level of performance degradation as their non-gated counterparts. Therefore, when measured in terms of their average power, gated and non-gated signals show only a 1 to 2 dB difference in power for the same performance level.

When measured in terms of RxBMPD, most of the differences in signal degradation between interfering signal types disappear (impulsive signal type exempted since these were not measured). Even then, there are trends, with gated signals being slightly more invasive and signals with spectral lines being slightly less invasive than Gaussian noise-like signals.